my sympy and python cheat sheet

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1 How to solve a first oder ODE?

Solve $y'(x) = 1 + 2x$ for $y(x)$

```
import sympy
x   = sympy.symbols('x')
y   = sympy.Function('y')
ode = sympy.Eq(sympy.Derivative(y(x),x),1+2*x)
sol = sympy.dsolve(ode,y(x))
#    Eq(y(x), C1 + x**2 + x)
sympy.checkodesol(ode,sol)
#    (True, 0)
```

2 How to solve a first oder ODE with initial condition?

Solve $y'(x) = 1 + 2x$ for $y(x)$ with $y(0) = 3$

```
import sympy
x   = sympy.symbols('x')
y   = sympy.Function('y')
ode = sympy.Eq(sympy.Derivative(y(x),x),1+2*x)
sol = sympy.dsolve(ode,y(x),ics={y(0):3})
#    Eq(y(x), x**2 + x + 3)
sympy.checkodesol(ode,sol)
#    (True, 0)
```

3 How to solve and ODE and convert the result to latex string?

Solve $y'(x) = 1 + 2x$ for $y(x)$ with $y(0) = 3$

```
import sympy
x   = sympy.symbols('x')
y   = sympy.Function('y')
ode = sympy.Eq(sympy.Derivative(y(x),x),1+2*x)
sol = sympy.dsolve(ode,y(x),ics={y(0):3})
#    Eq(y(x), x**2 + x + 3)
sympy.latex(sol)
```

$$y(x) = x^2 + x + 3$$

4 How to solve a PDE in sympy?

PDE solving is still limited in sympy. Here is how to solve first order pde

Solve $u_t(x,t) = u_x(x,t)$

```
import sympy as sp
x,t   = sp.symbols('x t')
u     = sp.Function('u')
pde   = sp.Eq( sp.diff(u(x,t),t) , sp.diff(u(x,t),x))
sol   = sp.pdsolve(pde)
sp.latex(sol)
```

$$u(x,t) = F(t + x)$$

5 How to check if something is derivative?

```
import sympy
x    = sympy.symbols('x')
y    = sympy.Function('y')
expr = sympy.Derivative(y(x),x)
type(expr) is sympy.Derivative
        #True

if type(expr) is sympy.Derivative:
   print("yes")

         #yes
```

This also works, which seems to be the more prefered way

```
isinstance(expr,sympy.Derivative)
   #True
```

6 How to find function name and its arguments in a proc?

Suppose one passes $y(x)$ to a function, and the function wants to find the name of this function and its argument. Here is an example

```
def process(the_function):
    print("the function argument is ", the_function.args[0])
    print("the function name itself is ", the_function.name)
```

```

import sympy
x   = sympy.symbols('x')
y   = sympy.Function('y')
process(y(x))
```

This prints

```
the function argument is  x
the function name itself is  y
```